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ABSTRACT VOLUME

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[43] THE PHREATIC AQUIFER OF THE ISONZO PLAIN (NE ITALY): HYDRODYNAMIC AND VULNERABILITY

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Introduction

The Isonzo-Soča High Plain is located in the eastern side of the Friuli Venezia Giulia Region, across the border between Italy and Slovenia. It holds a significant phreatic aquifer that represents an important natural wealth, in terms of quantity, quality and ease of supply. The aquifer is used for various activities such as drinking, household, industrial, agricultural and farming purposes. The increasing interest of the resident population for this important resource has given rise to "GEP" and "ASTIS" Projects, funded by the Programme for the cross-border cooperation Italy-Slovenia 2007-2013. As part of these projects, the present research focuses on the characterization of the phreatic aquifer of the Isonzo-Soča plain in order to evaluate its intrinsic vulnerability. Moreover it aims to safeguard the groundwater resource and support the environmental protection and management policies.

Hydrogeological settings

The Isonzo-Soča Plain is constituted almost entirely by quaternary alluvial deposits of Isonzo-Soča, Torre, Judrio, and Versa rivers. It is divided in two areas: the High Plain to the North and the Low Plain to the South (Fig. 1).

The High Plain is delimited to the North by the Collio Hills, constituted by marlstones and sandstones of the Flysch Formation, and to the South by the limestones reliefs of the Karst Plateau. It is constituted mainly by coarse and very permeable sediments that hold a well-developed phreatic aquifer. The rivers dissipate a great amount of water during their way in the High Plain; for this reason Torre and Judrio rivers remain dry most of the year while Isonzo loses about 26% of its discharge (Zini et al. 2013). These river losses, together with rain and run-off waters coming from the hills and karst waters from the underground, feed the phreatic aquifer of the High Plain.

Towards the Low Plain, the phreatic aquifer joins with a multi layered aquifer system characterized by alternating gravel-sand and clay-silt deposits. Due to the southward permeability decrease, the High Plain phreatic waters outflow in correspondence to a NW-SE wide area.

Ground water monitoring

Prior to the vulnerability assessment various investigations have been performed and integrated to the bibliographic data to better constrain the hydrogeological behavior of the system.

A monitoring survey (44 monitoring stations) was realized in order to elaborate the water table map in high flow conditions. Recovery and aquifer pumping test were performed to better define the hydrogeological parameters. Four seismic sections were realized to evaluate the alluvial thickness. In addition, major ions concentrations and isotopic composition were measured.

Consequently, isobaths of the bedrock, isopachs of the alluvial deposits, isophreatics and hydrochemical maps were elaborated.

Intrinsic vulnerability assessment

In order to evaluate the intrinsic vulnerability the SINTACS method (Civita and De Maio 2000) was used. It is a point count system model and considers the following seven parameters: depth to groundwater table, effective infiltration, unsaturated zone attenuation capacity, soil attenuation capacity, hydrogeological characteristics of the aquifer, hydraulic conductivity and topographical slope. Spatial knowledge of all these factors and their mutual relationship are needed to model the aquifer vulnerability. Furthermore, the method uses different weight coefficient multipliers for every hydrogeological environments.

First, the study area were discretized with a grid cell of 10 × 10 meters. A 3D model of the bedrock was realized using ArcGIS software and geostatistical interpolation, starting from

lithostratigraphic and seismic data.
A dedicated geodatabase was designed to express each of SINTACS parameters as a spatial thematic layer with a specific weight and score. SINTACS layers were prepared using bibliographic and survey data such as effective precipitation, water table, hydraulic conductivity, geology, pedology and digital elevation model.
The intrinsic vulnerability index was produced for each grid cell by taking the amount of each score parameter multiplied by its specific weight.

Results

The monitoring activities highlighted the large contribution of the Isonzo/Soča river in feeding the aquifer in the central and eastern parts of the plain. Conversely the western part suffers from the influence of the Torre river, while in the northern part the underground waters flow through the Classical Karst aquifer, feeding it.
The SINTACS vulnerability map shows that the Isonzo/Soča plain is rather vulnerable because of its hydrogeological characteristics: the most exposed areas occur in correspondence to the riverbeds and, in the South, to the contact between High and Low Plain, where resurgences of waters occur.

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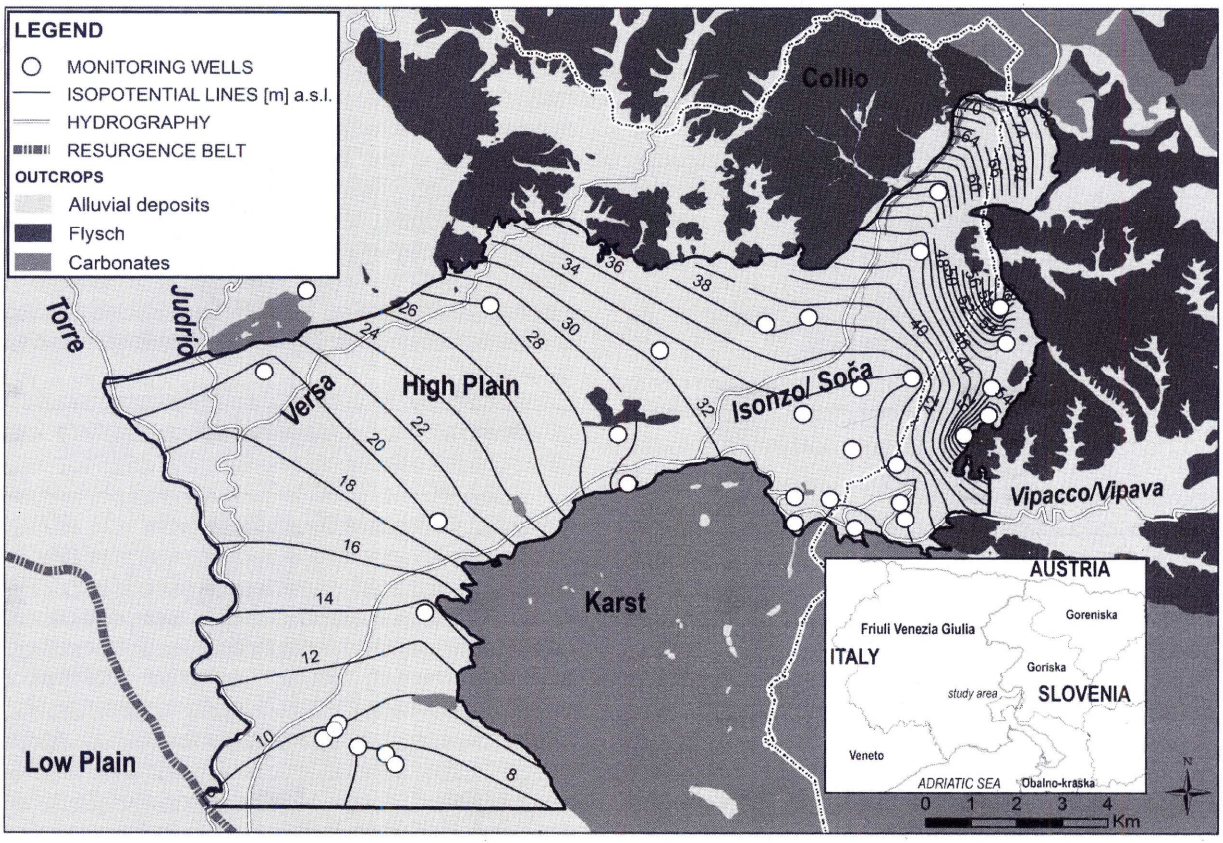

Fig. 1 – Hydrogeological map of the study area.